

MODIFICATION OF THE
INTERSEGMENTAL REGION IN THE
PTEROTHORAX OF *CRYPHOCRICOS*
(HETEROPTERA: NAUCORIDAE)*

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INTRODUCTION

In most Hydrocorisae (aquatic Heteroptera) the hindlegs are used for swimming, and their extrinsic muscles, which originate in the metathorax, are well developed. The tergal and pleural depressors of the metathoracic trochanter (Muscles 70 and 71, respectively, of Larsén, 1945) are especially large in many Hydrocorisae, including the Naucoridae (Larsén, 1945) and the closely related family Aphelocheiridae (Parsons, 1969). These muscles slant anterolaterally in the metathorax, their anteriormost fibers originating near its boundary with the mesothorax.

In at least three genera of Naucoridae (*Limnocoris*, *Ambrysus*, and *Cryphocricos*) the anterior part of the metathoracic episternum, on which Muscle 71 originates, usually projects into the cavity of the preceding segment. This makes it appear, at first glance, that the anteriormost fibers of the muscle attach on the mesothorax. The metapleural projection, which will be described in a later publication, appears to be produced by post-ecdysial growth of the skeleton, since it is absent in newly-moulted adults and is present only in older ones.

Another example of post-ecdysial skeletal change occurs in the tergum of adult *Cryphocricos barozzii* and makes the anteriormost fibers of Muscle 70 appear to originate on the mesothorax rather than on the metathorax. This tergal modification seems to occur only in micropterous specimens, with reduced forewings. I have not observed it in macropterous *Cryphocricos* or in *Ambrysus*, *Limnocoris*, or *Pelocoris*, all of which possess forewings of normal length.

MATERIALS AND METHODS

Cryphocricos barozzii Signoret, collected in Nova Teutônia, Brazil, and preserved in 70% alcohol, were dissected in 80% alcohol under

*Manuscript received by the editor January 20, 1974.

a stereoscopic microscope. The attachment of Muscle 70 was studied by cutting the tergum sagittally, with a razor blade; the cut was made half way between the ventral phragmal process and the base of the mesothoracic wing. A few *Pelocoris femoratus* Palisot-Beauvois, preserved in Bouin's fluid, were also examined for comparison.

Most of the *Cryphocricos* were micropterous, lacking hindwings and indirect flight muscles and possessing forewings which reached only as far as the third abdominal segment. Only two of the rare macropterous forms, with forewings and hindwings extending nearly to the tip of the abdomen, were available for the investigation. Although they were not extensively dissected, their indirect flight muscles appeared to be either degenerate or absent.

Newly-moulted *Cryphocricos* could be distinguished from older individuals by the thinness of their exoskeletons and by the distinctness and relative thickness of the underlying epithelial layer. In older specimens the epithelium was thinner, less distinct, and easily torn, and the thickened exoskeleton had a layered appearance, probably owing to the deposition of successive internal layers of endocuticle after ecdysis, as Neville (1970) has observed in several insects. These layers could be peeled away from each other in an older specimen of *Cryphocricos* which had been immersed for 24 hours in a concentrated solution of potassium hydroxide.

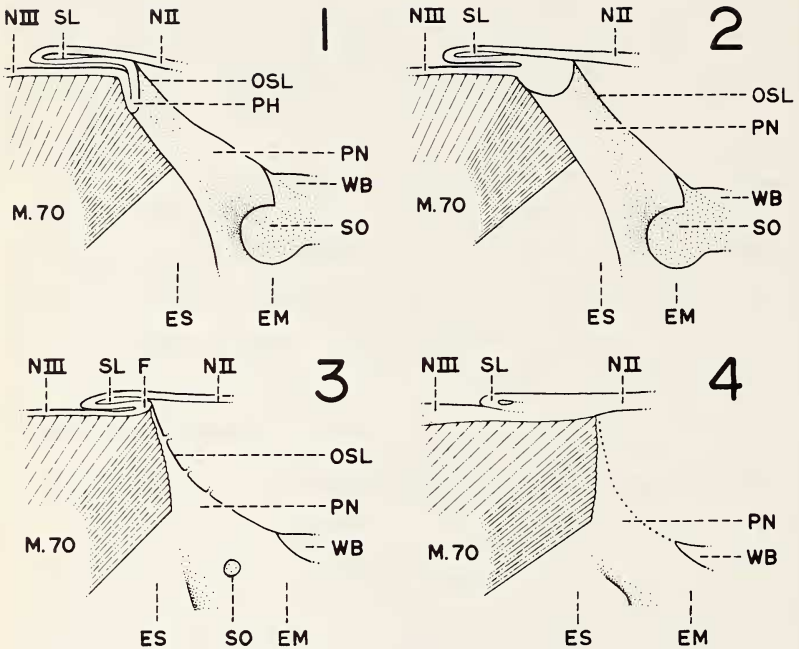
OBSERVATIONS

Typical Naucoridae

(figs. 1, 5)

In most macropterous naucorids, such as *Pelocoris*, the posterior margin of the mesothoracic notum (fig. 1; N II) is evaginated, forming a double-walled scutellar lobe (SL). The opening into the lobe (OSL) extends anterolaterally to the base of the forewing (WB). Immediately ventral to this opening lies the well developed mesothoracic postnotum (PN), which bears the second phragma (PH). The postnotum separates the metathoracic notum (N III) from the scutellar lobe and is mostly concealed by the latter externally. Only its most lateral part, which joins the mesothoracic epimeron (EM), forming a postalar bridge, is externally visible. The postalar bridge bears a large sensory membrane (SO), part of the mesothoracic scolopophorous organ (Larsén, 1957).

The concealed medial portion of the postnotum forms a two-walled, vertical invagination, the second phragma (PH). The



Figures 1-4, Diagrammatic internal views of dorsolateral intersegmental region of pterothorax in various adult Naucoridae. Left side of body has been cut parasagittally through terga (cut edge), between ventral phragmal process (not shown) and wingbase (WB). Fig. 1. Typical macropterous Naucoridae (based on *Pelocoris femoratus*). Fig. 2. Macropterous *Cryphocricos barozzii*. Fig. 3. Newly-moulted micropterous *C. barozzii*. Fig. 4. Older micropterous *C. barozzii* (dotted line indicates approximate position of opening into scutellar lobe, which is no longer visible).

phragma is especially pronounced on either side of the midline, where it bears a pair of large ventral processes (fig. 5; VP) upon which two of the mesothoracic indirect flight muscles attach (Muscles 30 and 31 of Larsén, 1945; present but degenerate in most *Pelocoris*).

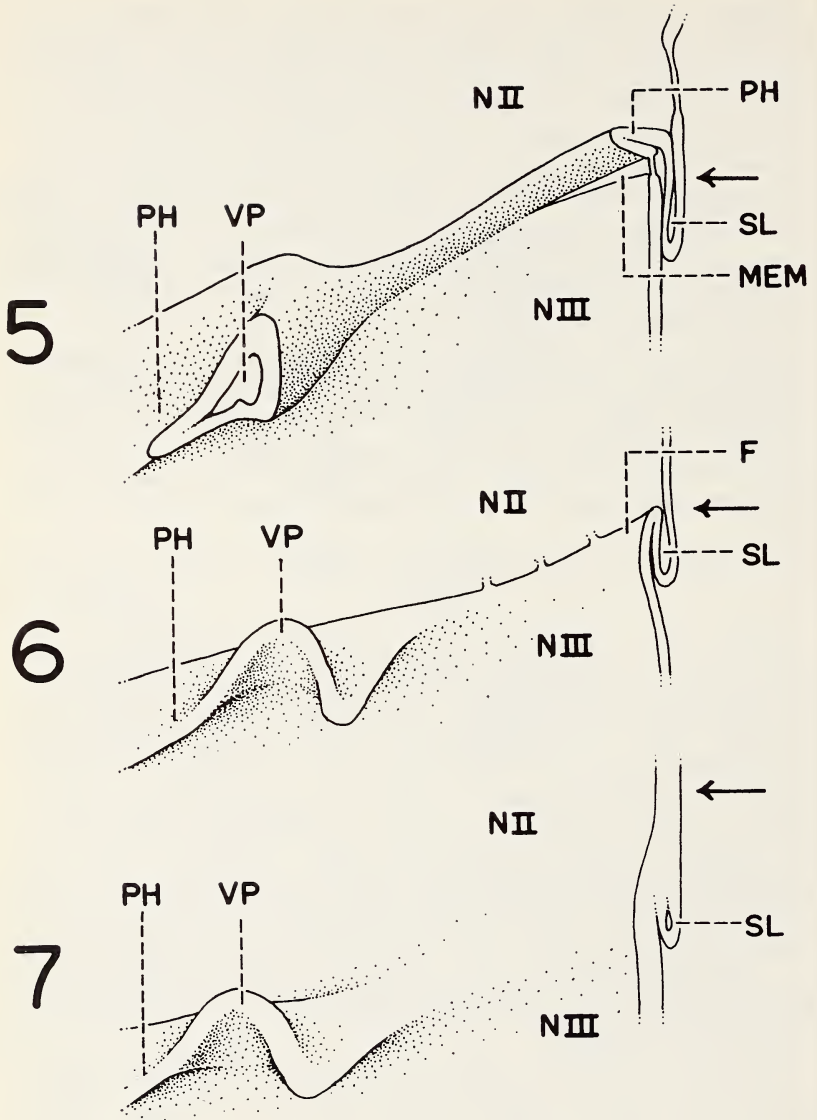
According to Snodgrass (1935) the phragma represents the primary boundary (antecosta) between the metathorax and mesothorax, and the mesothoracic postnotum is thus an intersegmental plate which is only secondarily associated with the mesothorax. This interpretation, which has been challenged by Matsuda (1970), is supported by the fact that the posterior wall of the phragma is continuous with the metathoracic episternum (fig. 1; ES).

Muscle 70 (fig. 1; M. 70) originates posterior to the phragma and postnotum, its fibers attaching only on the metathoracic notum. The latter forms a sharp angle with the posterior wall of the phragma. The angle is sclerotized medially (fig. 1) but contains a narrow membrane laterally (fig. 5; MEM). The membrane lies immediately anterior to the origin of Muscle 70.

Macropterous *Cryphocricos* (fig. 2)

Most of the typical structural relationships described above are also present in macropterous *Cryphocricos*. In the latter, however, the postnotum forms a definite, double-walled second phragma only near the midline, at and between the ventral processes (position same as in micropterous *Cryphocricos*, figs. 6, 7). Lateral to the ventral processes the postnotum does not seem to be invaginated, and appears merely as a transverse thickening (fig. 2, PN) just posteroventral to the opening into the scutellar lobe (OSL). Neither of the two available macropterous specimens were newly-moulted. It is thus possible that a low, double-walled phragmal invagination is present in this region immediately after ecdysis. As new layers of endocuticle are subsequently laid down, the structure of the phragma could become obscured, giving it the appearance of an uninvaginated thickening in older specimens.

Laterally the anterior portion of the postnotal thickening forms a well-defined postalar bridge with the mesothoracic epimeron (EM). The bridge contains a large sensory membrane (SO) similar to that of typical naucorids. The posterior portion of the postnotal thickening is continuous laterally with the metathoracic episternum (ES) and medially with the metanotum (N III). Its boundary with the



latter is marked dorsolaterally by a narrow, unpigmented band of sclerotization, the homologue of the membrane (fig. 5; MEM) which is present in typical Naucoridae. Muscle 70 originates only on the metanotum, posterior to this band, as in other macropterous naucorids, and its fibers do not extend onto the postnotum (fig. 2).

Micropterous *Cryphocricos* (figs. 3, 4, 6, 7)

In short-winged *Cryphocricos*, as in macropterous ones, a well-defined second phragma (figs. 6, 7; PH) is present only at and between the ventral phragmal processes (VP). In addition, the mesothoracic postnotum appears to be incomplete in micropterous *Cryphocricos*. These skeletal modifications are more easily observed in newly-moulted adults (figs. 3, 6) than in older ones in which parts of the thickened exoskeleton have coalesced (figs. 4, 7).

In newly-moulted specimens the portion of the postnotum which usually lies immediately lateral to the ventral phragmal processes appears to have disappeared. The scutellar lobe (figs. 3, 6; SL) is shorter than in macropterous *Cryphocricos*, and its ventral wall is directly continuous medially with the metanotum (N III), upon which Muscle 70 originates. The junction between these two regions forms a fold (F) which projects anteriorly and is continuous with the phragmal process (fig. 6). Short, sclerotized struts connect its edge secondarily with the mesonotum (N II). The anteromedial fibers of Muscle 70 originate on the edge of this fold, immediately beneath the opening into the scutellar lobe (fig. 3; OSL). They thus attach farther anteriorly than in macropterous *Cryphocricos* (fig. 2), in which they originate well posterior to the opening.

The more anterolateral fibers of Muscle 70 do not attach to the edge of the fold but are separated from it by a roughly triangular area which represents the lateral portion of the incomplete postnotum (fig. 3; PN). There is no membrane or unpigmented band marking its posterior boundary with the metanotum. It is ventrally continu-

Figures 5-7, Diagrammatic internal views of intersegmental part of pterothoracic terga in various adult Naucoridae. Terga have been cut parasagittally, medial to wingbases, and removed from body; only left side, between ventral phragmal process (VP) and cut edge, is shown. Arrow indicates level at which anteriormost fibers of Muscle 70 originate. Fig. 5. *Pelocoris femoratus* (ventral phragmal process cut off at base). Fig. 6. Newly-moulted micropterous *Cryphocricos barozzii*. Fig. 7. Older micropterous *C. barozzii*.

ous with the mesothoracic epimeron (EM), and the postalar bridge contains a very reduced scolopophorous organ (SO).

In older micropterous *Cryphocricos* skeletal boundaries are much more difficult to interpret, owing to the thickening of the cuticle, the differential growth of some regions, and the obliteration of folds, making them appear as solid thickenings rather than hollow invaginations or evaginations. Comparison of older specimens (fig. 4) with newly-moulted ones (fig. 3) indicates that during post-ecdysial development several changes have occurred in the lateral and dorso-lateral intersegmental region of the pterothorax. The scolopophorous sense organ is no longer visible on the internal surface of the postalar bridge. The cavity of the scutellar lobe (fig. 4; SL) has been reduced, and the opening into the lobe (fig. 4; dotted line) is no longer visible. The ventral wall of the lobe merges indistinguishably with the fold which borders on it ventrally. In newly-moulted *Cryphocricos* this well-defined fold (fig. 3; F) marks the boundary of the scutellar lobe with the metanotum medially (fig. 3; cut edge) and with the postnotum laterally (PN). In older adults these boundaries have become obscured. The fold and scutellar lobe appear as three separate layers only posteriorly; more anteriorly they appear as a single, somewhat thickened layer (fig. 4).

In addition, the anteromedial fibers of Muscle 70, which originate on the metanotum, attach considerably more anteriorly in older *Cryphocricos* than in younger ones (figs. 3, 4; M. 70; figs. 6, 7; arrows). This suggests that the fold (figs. 3, 6; F) between the scutellar lobe and the metanotum grows anteriorly as new layers of endocuticle are added to the internal surface of the skeleton. One older specimen, in which the muscle attached at the level indicated by the arrow in Figure 7, was treated in potassium hydroxide so that the more internal layers of endocuticle could be peeled away from the outermost ones. Although the inner layers lacked a fold, the more external ones showed a definite one which lay posterior to the level at which the muscle fibers had originated.

DISCUSSION

In these descriptions I have taken the view that Muscle 70 originates on the metanotum in all four types of Naucoridae. In the two macropterous forms (figs. 1, 2) its origin is separated from the meso-scutellar lobe by the postnotum. In micropterous *Cryphocricos* (figs. 3, 4), however, a portion of the postnotum, immediately lateral to the

ventral phragmal process, is absent. In this region, consequently, the part of the metanotum on which Muscle 70 originates borders directly on the scutellar lobe. This atypical intersegmental boundary appears to grow anteriorly during post-ecdysial development.

Figures 3 and 4 could be interpreted in two other ways, either (1) that there are no post-ecdysial changes in skeletal boundaries and that in Figure 4 the anteriormost fibers of Muscle 70 have simply shifted anteriorly, onto the mesonotum, or (2) that a post-notum is present lateral to the phragmal process and is represented by the fold (fig. 3; F) upon which the anteromedial fibers of Muscle 70 attach. According to this second view the origin of the muscle has shifted from the metanotum onto the homologue of the thickened postnotum of macropterous *Cryphocricos* (fig. 2; PN). Consequently, it is the boundary between the mesothoracic scutellum and postnotum (secondary intersegmental boundary of Snodgrass, 1935) which appears to grow anteriorly after ecdysis, rather than a primary intersegmental boundary. Neither of these two interpretations has been adopted here because in *Cryphocricos* and at least two other genera of Naucoridae post-ecdysial skeletal growth takes place in the pterothoracic pleuron (see p. 46) and almost certainly occurs along the primary intersegmental boundary between the metathoracic episternum and the mesothoracic epimeron.

Degeneration or absence of the three mesothoracic indirect flight muscles, and consequent loss of the ability to fly, is a common occurrence among Hydrocorisae (Larsén, 1950). Extreme alary dimorphism such as that of *Cryphocricos* is much less common. Larsén (1950) studied *Aphelocheirus* (Aphelocheiridae) which has both micropterous and macropterous forms, and found that the size and shape of the ventral phragmal processes, upon which two of the indirect flight muscles attach, differ in the two types. Similar differences in the phragmal processes occur in flying and flightless *Ilyocoris* (Naucoridae; Larsén, 1970). Both forms of *Ilyocoris* possess forewings and hindwings of normal length, but most individuals lose their indirect flight muscles soon after the final moult. Larsén did not, however, observe post-ecdysial skeletal changes, absence of the lateral part of the second phragma, or loss of a portion of the mesothoracic postnotum in either *Aphelocheirus* or *Ilyocoris*. All these features appear to occur in micropterous *Cryphocricos*.

ACKNOWLEDGEMENTS

I wish to thank Fritz Plaumann (Nova Teutônia, Brazil) for

collecting the *Cryphocricos*, John Polhemus (Englewood, Colorado) for identifying them, my husband, Thomas Parsons, for examining the manuscript, and Donald Chant and the Department of Zoology, University of Toronto, for making available the laboratory facilities for this research. The investigation was made possible by a grant from the National Research Council of Canada.

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